CORRELATED ISOTOPE ANOMALIES ON THE WING OF THE IRON ABUNDANCE PEAK

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The measurement of isotope anomalies for many elements in the same samples has shown the presence of significant correlations which have permitted the identification of contributions from specific nucleosynthetic processes (e.g., enhancements in the "r"-process isotopes at the higher Z region of Ba, Nd, Sm). At lower Z, on the low mass number wing of the Fe abundance peak, a significant correlation has been established for isotopic anomalies in Ca and Ti. These correlations are particularly important for the FUN, Ca-Al-Ti-rich inclusions which show large isotope effects. Using a normalization to $^{40}Ca/^{44}Ca$ and $^{46}Ti/^{48}Ti$, the Ca and Ti data on the FUN samples show the presence of several distinct components: a) large effects (both excesses and deficits) in ^{48}Ca and ^{50}Ti; these effects are correlated in sign and in magnitude; b) large effects in ^{49}Ti in the FUN inclusions; the signs of the ^{49}Ti and the ^{48}Ca-^{50}Ti effects are correlated; c) large excesses in ^{47}Ti in the two FUN inclusions (C-1 and EK-1-4-1), although these inclusions show correlated effects (excesses or deficits) in $^{49,50}Ti$ and ^{48}Ca; d) small effects at ^{42}Ca (both excesses and deficits); e) ^{46}Ca effects which are null, or a factor of five smaller than the ^{48}Ca effects in the same samples, despite the extremely low abundance of ^{46}Ca in nature. Typical Ca-Al-Ti-rich inclusions from Allende and Leoville also contain endemic ^{50}Ti effects and less frequent but clear deficits in $^{47,49}Ti$. Consideration of the nucleosynthetic processes for the nuclides on the wing of the Fe peak shows: a) production of ^{48}Ca and ^{50}Ti in neutron-rich, quasi-equilibrium Si burning; production of ^{54}Cr along with ^{48}Ca and ^{50}Ti in neutron-rich equilibrium burning; b) production of $^{47,49,50}Ti$ from reactions on seed nuclei in explosive carbon burning; c) production of ^{46}Ti and of ^{50}Cr in explosive oxygen burning without contributions to the other Ti and Cr isotopes. The ^{48}Ca-^{50}Ti effects and the absence of ^{46}Ca effects indicate neutron-rich equilibrium or quasi-equilibrium nucleosynthesis. From A.G.W. Cameron's calculations, for neutron-rich equilibrium ^{50}Ti and ^{54}Cr are overproduced relative to ^{48}Ca by factors of 14 and 10, while for neutron-rich Si burning ^{50}Ti is over-produced only by a factor of 2 relative to ^{48}Ca while ^{54}Cr is not produced. Therefore, the comparable size of the ^{48}Ca and ^{50}Ti effects in the FUN samples points towards neutron-rich quasi-equilibrium synthesis while the more endemic nature of the ^{50}Ti effects (without comparable ^{48}Ca effects) in non-FUN inclusions would be more plausible for neutron-rich equilibrium burning. The measurement of the Cr isotope abundances in these inclusions will permit a resolution of this matter. From the ^{48}Ca-^{50}Ti correlation it is clear that we are sampling material produced very near the core of a supernova. The presence of ^{47}Ti excesses in both FUN inclusions, coupled with the near absence of 46Ca effects, must be considered as significant constraints for the production of these rare nuclei by reactions on seed nuclei on the wings of the Fe peak. The effects in these nuclei should provide strong limits on the timescale of the processes involved and on the possibility of by passing ^{46}Ca. We consider that the Ca and Ti effects require the presence both of neutron-rich equilibrium or quasi-equilibrium burning and of reactions on seed nuclei to produce the ^{47}Ti effects. The more general problem of nucleosynthesis on the wings of the Fe peak requires serious attention since all the Ti isotopes are significantly underproduced relative to Fe and Cr.

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FISSION TRACKS IN THE MARJALAHTI PALLASITE

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Approximately 100 phosphates crystals were extracted from 4 g of silicate obtained as a sawing residue from the meteorite Marjalahti. The crystals come from various locations in the meteorite and the cosmic-ray track densities in the olivine range from 0.2 to 8.10^6 cm^{-2}. The phosphates are merrillite (previously called whitlockite) grains and their fossil track densities range from 16 to 42.10^6 cm^{-2}. A lower limit of the fission track contribution in some of the merrillite grains is at least 18.10^6 cm^{-2}. This estimate is arrived at by assuming that there was no annealing of fission or cosmic-ray tracks in the phosphate, and that the Fe track production ratio between phosphate and olivine is a factor of 3. However, the following evidence suggests that high